STUDIES ON THE TALITRIDAE (AMPHIPODA, CRUSTACEA) IN JAPAN II. TAXONOMY OF SEA-SHORE ORCHESTIA, WITH NOTES ON THE HABITATS OF JAPANESE SEA-SHORE TALITRIDS

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STUDIES ON THE TALITRIDAE (AMPHIPODA, CRUSTACEA) IN JAPAN II. TAXONOMY OF SEA-SHORE *ORCHESTIA*, WITH NOTES ON THE HABITATS OF JAPANESE SEA-SHORE TALITRIDS[1]

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Seto Marine Biological Laboratory

With Text-figures 1–18 and Tables 1–2

The genus *Orchestia* occurs not only in the supralittoral zone of the sea shore, but also in inland areas far from the sea. The animals, for example, have been collected on the coast of lakes, from the margin of swamps, and in the litters in forests. The sea shore species in Japan have been reported by Iwasa (1939) and Stephensen (1944) and then partially revised by Bulycheva (1957). My collecting trips made recently along the coasts from Hokkaido to Yoron Island revealed no new species, but a few forms, supposed to be terrestrial according to the knowledges hitherto reported, have also been met with. In the present paper, I am going to redescribe the following species and propose a taxonomical amendment on them:

1) *Orchestia platensis* Krøyer,
2) *Orchestia pachypus* (Derzhavin),
3) *Orchestia pyatakovi* Derzhavin, and
4) *Orchestia ochotensis* Brandt.

In addition, notes on the habitats of *Orchestoidea trinitatis*, *Talorchestia nipponensis*, *T. sinensis*, *Orchestia platensis*, *O. pachypus* and *O. pyatakovi* will be given to support my opinion in the preceding paper (Morino, 1972), suggesting the importance of habitat consideration in the taxonomy of this group of animals. The taxonomy of terrestrial forms provides an interesting subject from the view point of land invasion by crustaceans, but has been done very poorly in Japan so far. This attractive investigation is reserved at present for further paper.

I would like to express my sincere gratitude to Professor T. Tokioka, Dr. E. Harada and Dr. S. Nishimura for critical reading of the manuscript and giving me helpful discussions.

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Descriptions

Orchestia platensis Krφyer, 1845

(Text-figs. 1–3)

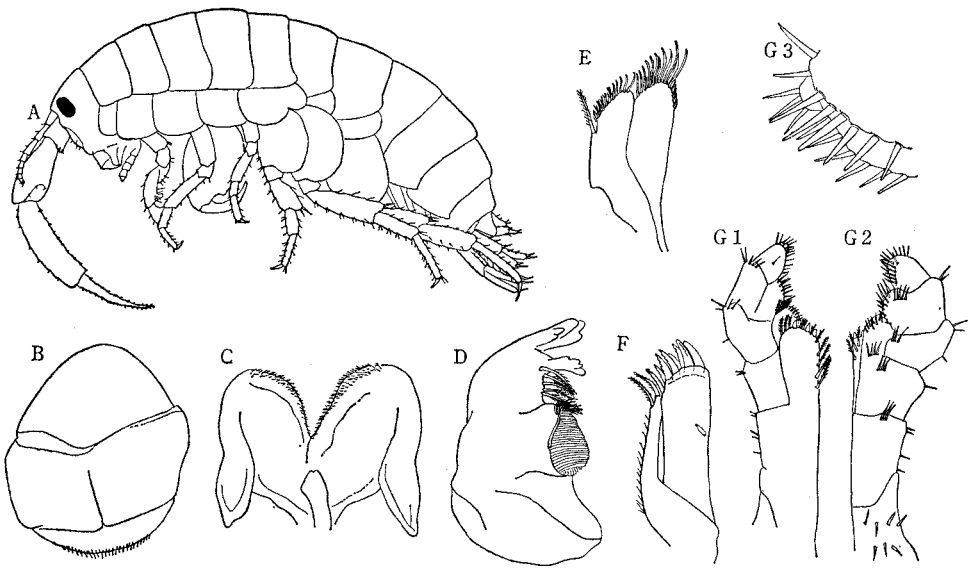
Orchestia platensis, Stebbing 1906, pp. 540–541.
Chilton 1921, pp. 538–541, Text-fig. 7.
Chevreux and Fage 1925, pp. 276–277, fig. 287.
Iwasa 1939, pp. 257–261, Text-figs. 1–3, pl. IX.
Stephensen 1944, pp. 57–58, figs. 15–16.
Gurjanova 1951, pp. 807–808, fig. 562.
Bulycheva 1957, pp. 159–162, fig. 57.

Material examined: Specimens from Hatakejima Island (Tanabe Bay in Wakayama Prefecture) and several other localities have been examined.

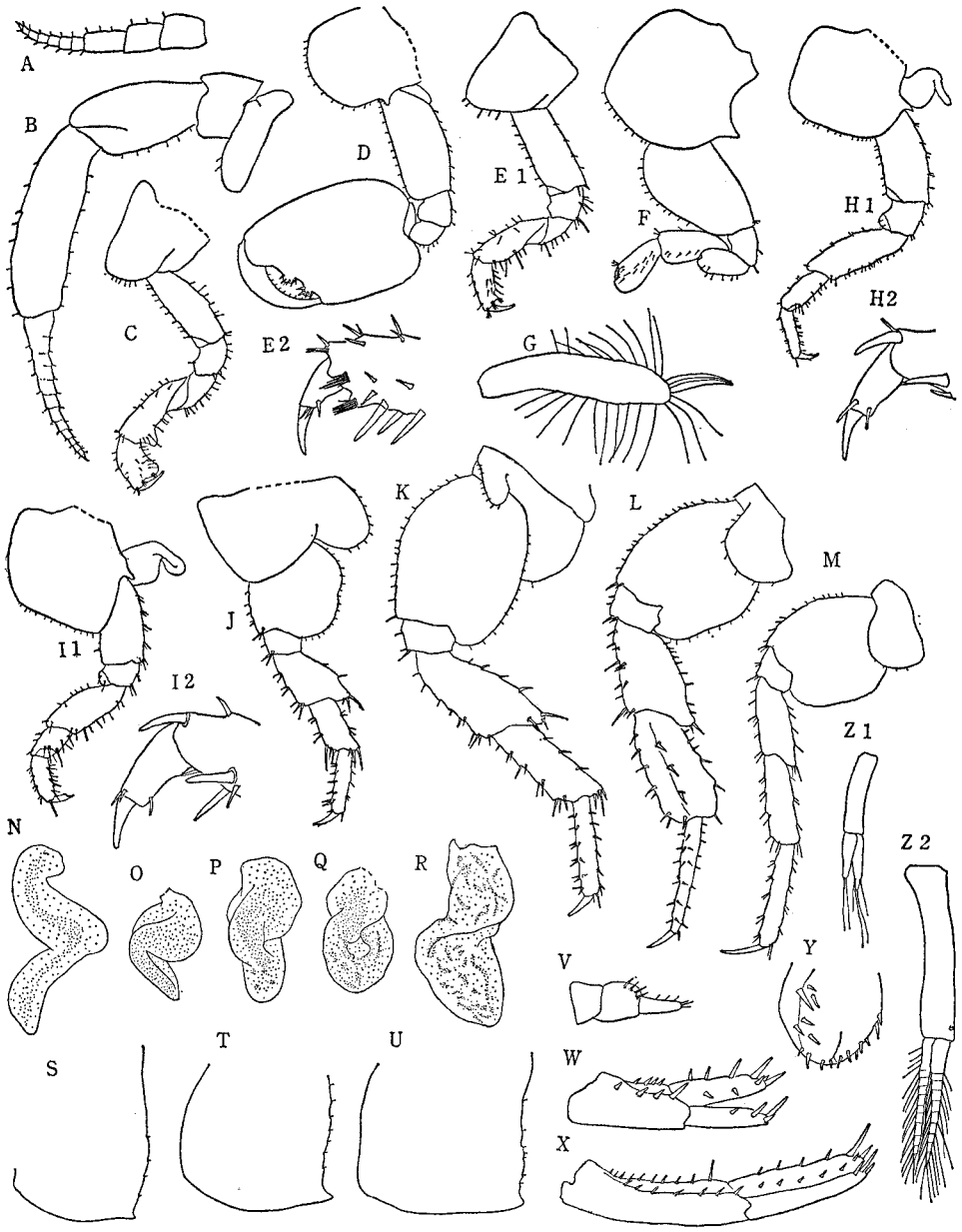
Description: Male slightly larger than female.

Body more or less robust. Eyes black and oblong oval.

Antenna I almost reaching the distal end of the antipenultimate article of antenna II; peduncle longer than flagellum, 3 articles of peduncle nearly equal in length; flagellum consisted of about 7 articles in adult, 15.6 mm in body length (cf. 2 articles, 2.5 mm in body length; immediately after hatching out). Antenna II shorter than half but longer than one-third of the body length; peduncle longer than flagellum and getting incrassated in large male specimen, distal article longest and about twice as long as antipenultimate article; flagellum consisted of about 16 articles in adult



Text-fig. 1. *Orchestia platensis*, A, lateral view (X5); B, upper lip (X40); C, lower lip (X40); D, mandible (X40); E, maxilla II (X40); F, maxilla I (X40); G1, ventral view of maxilliped (X32.5); G2, dorsal view of maxilliped (X32.5); G3, distal articles of maxilliped (X165); male, 15.6 mm, from Hatakejima Island, 12 May, 1972.

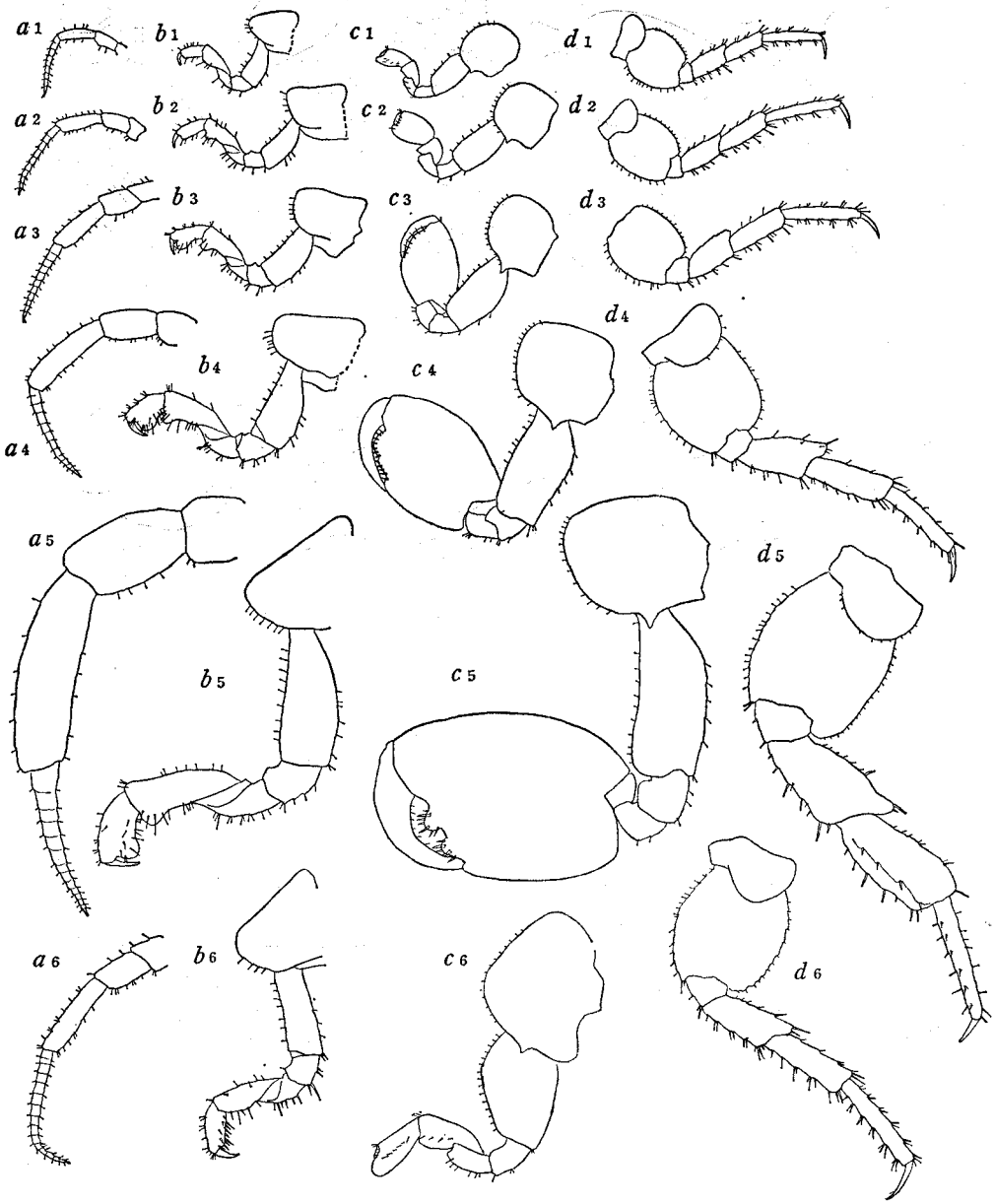


Text-fig. 2. *Orchestia platensis*, A, antenna I (X10); B, antenna II (X10); C, male gnathopod I (X10); D, male gnathopod II (X10); E1, female gnathopod I (X13.5); E2, distal articles of female gnathopod I (X48); F, female gnathopod II (X13.5); G, oöstegite (X13.5); H1, pereiopod I (X10); H2, distal articles of pereiopod I (X48); I1, pereiopod II (X10); I2, distal articles of pereiopod II (X48); J, pereiopod III (X10); K, pereiopod IV (X10); L, male pereiopod V (X10); M, female pereiopod V (X10); N, gill I (X16.5); O, gill II (X16.5); P, gill III (X16.5); Q, gill IV (X16.5); R, gill V (X16.5); S, epimeral plate I (X16.5); T, epimeral plate II (X16.5); U, epimeral plate III (X16.5); V, uropod III (X16.5); W, uropod II (X16.5); X, uropod I (X16.5); Y, telson (X27.5); Z1, pleopod I of young (X48); Z2, pleopod I (X16.5); male, 15.6 mm, female, 13.2 mm, young, 2.6 mm from Hatakejima Island, 12 May, 1972.

(15.6 mm in body length) (cf.3 articles, 2.5 mm in body length).

Lower lip with minute inner lobe. Maxillipedal palp with minute, indistinct 4th article.

Gnathopod I in male subchelate; 1st article narrow with strong spines on the



Text-fig. 3. *Orchestia platensis*, successive change of secondary sexual characters; *a*, antenna II (X10); *b*, gnathopod I (X13.5); *c*, gnathopod II (X13.5); *d*, pereiopod V; 1, 6.5 mm; 2, 8.1 mm; 3, 9.2 mm; 4, 10.7 mm; 5, 15.6 mm; 6, female, 13.2 mm; from Hatakelima Island, 12 May, 1972.

ventral margin, 5th article much longer than 6th, both with pellucid lobes; in female imperfectly subchelate, 5th article longer than 6th, both without pellucid lobe. Gnathopod II in male strongly developed; 1st article broad, 6th article very massive, palm with two tubercles, of which one situated near the hinge with 7th article wider than the other in most specimens, 7th article strongly curved in large specimens with minute setae on the grasping margin; in female 2nd article expanded, 5th article longer than 6th, both with pellucid lobes, 7th article minute.

Pereiopod I similar to pereiopod II, the latter slightly shortened. Pereiopod III with bi-lobed 1st article, 2nd article broad, 4th article expanded distally. Pereiopod IV with bi-lobed 1st article, posterior lobe large and covered by, while anterior lobe small and covering expanded 2nd article. Pereiopod V with simple 1st article, 5th article markedly increassated in large male specimens.

Pleopod well developed; peduncle longer than flagella; each flagellum consisted of about 10 articles in adult, 15.6 mm in body length (cf. 2 articles, 2.5 mm in body length).

Epimeral plate I with rounded antero-ventral corner. Plate III rectangular in form. Plate II intermediate. Each with serrated posterior margin.

Uropod I with peduncle longer than rami, with many spines on the dorsal margin; outer ramus only with apical spines while inner ramus with both marginal and apical spines. Uropod II with many strong spines on peduncle and rami. Uropod III with ramus nearly equal to peduncle.

Telson thick, with spines on the margin.

Gill I smooth, V-shaped. Gills II and III strongly curved. Gill IV broad and twisted. Gill V slightly bumped, broad and long, and constricted near the middle.

Oöstegite with about 30 bristles.

Distribution: For habitat, see later section. This species occurs very commonly along the coast of Japan (see Fig. 16, p. 188). Further distribution has been reported from South Sakhalin, Aniwa Bay, Kuril Island, Hawaii, Atlantic coast of North America, Bermuda Island, Montevideo, Denmark, Sweden, western Baltic and West Germany.

Remarks: No description of this species has ever referred to the 5th article of pereiopod V, which become markedly incrassated in large males. Monthly observations show that the specimens with incrassated 5th article appear from January to June in Tanabe Bay.

Orchestia pachypus (Derzhavin), 1937

(Text-figs. 4–7)

Talorchestia pachypus, Derzhavin, 1937, pp. 91, fig. 3.
Orchestia platensis japonica, Iwasa, 1939, pp. 261–263, figs. 4–6, Pl. X.
Stephensen, 1944, pp. 59–60, fig. 17.
Talorchestia pachypus, Gurjanova, 1951, pp. 812–813, fig. 567.
Bulycheva, 1957, pp. 146, fig. 52.

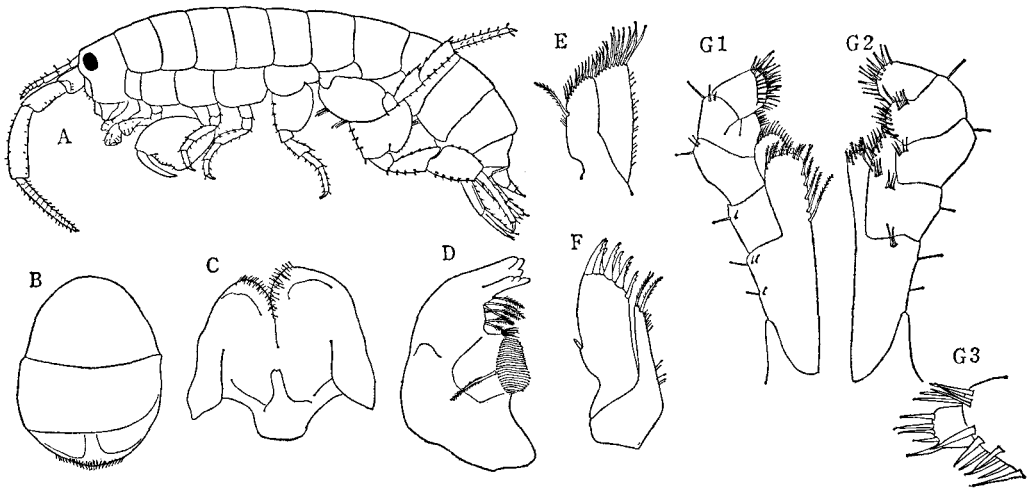
Material examined: Several specimens from Muroran in Hokkaido and Obama in

Fukui Prefecture have been examined.

Description: Male larger than female.

Body up to 14 mm in length in male, not strongly compressed. Eyes black and oblong oval.

Antenna I reaching the distal end of antipenultimate article of antenna II; articles of peduncle nearly equal; flagellum consisted of 4 or 5 articles in adult. Antenna II about one third as long as body; peduncle longer than flagellum, becoming incrassated in large male specimen, ultimate article almost equal to the preceding two articles combined, basal article broadened a little to fix on the front surface of head; flagellum consisted of 15 articles in adult, 14.0 mm in body length (cf. 7 articles, 4.4 mm in body length).

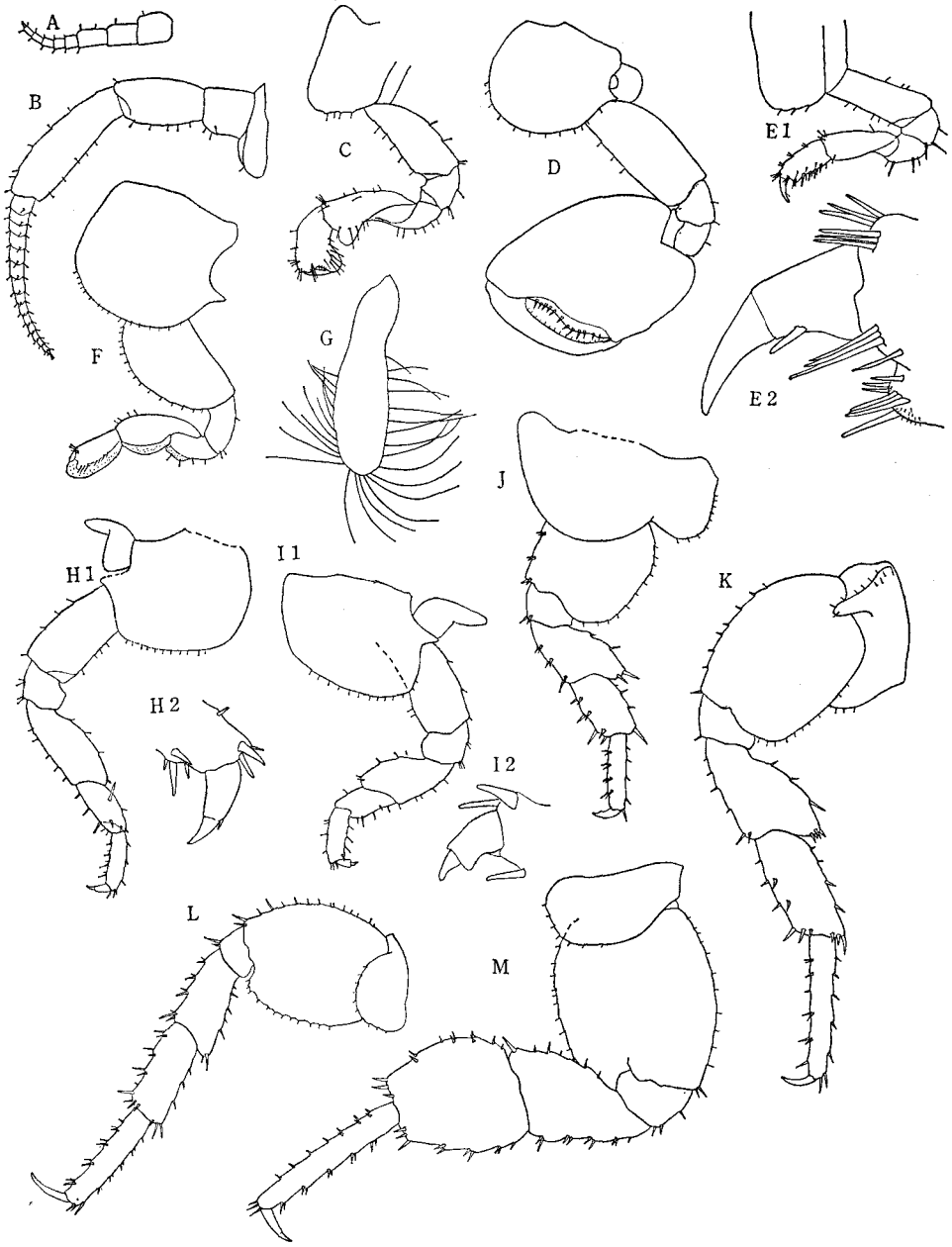


Text-fig. 4. *Orchestia pachypus*, A, lateral view (X5); B, upper lip (X40); C, lower lip (X40); D, mandible (X40); E, maxilla II (X40); F, maxilla I (X40); G1, dorsal view of maxilliped (X40); G2, ventral view of maxilliped (X40); G3, distal article of maxillipedal palp (X165); male, 14.0 mm, from Muroran, 25 Jun. 1971.

Lower lip with minute inner lobe. Forth article of maxillipedal palp minute and not always distinct.

Gnathopod I in male subchelate; 1st article longer than broad and armed with spines on the ventral margin, 5th article longer than 6th, both article with prominent pellucid lobes; in female 5th article longer than 6th, the latter with minute pelluicd lobe. Gnathopod II in male strongly developed, 1st article broad with a small process on the posterior margin, 6th article very massive, palm with a shallow concavity in the proximal half; in female 2nd article broad with rounded anterior margin, 5th article longer than 6th, 4th to 6th articles with pellucid lobe, 7th article minute.

Pereiopod I similar to pereiopod II, the latter being shorter and a little more robust than the former, 7th article of pereiopod II constricted strongly. Pereiopod III with bi-lobed 1st article as in pereiopod IV. Pereiopod IV much longer than



Text-fig. 5. *Orchestia pachypus*, A, antenna I (X10); B, antenna II (X10); C, male gnathopod I (X13.5); D, male gnathopod II (X13.5); E1, female gnathopod I (X16.5); E2, distal articles of female gnathopod I (X165); F, female gnathopod II (X16.5); G, oöstegite (X16.5); H1, pereipood I (X16.5); H2, distal articles of pereiopod I (X48); I1, pereiopod II (X13.5); I2, distal articles of pereiopod II (X48); J, pereiopod III (X13.5); K, pereiopod IV (X13.5); L, female pereiopod V (X13.5); M, male pereiopod V (X13.5); male, 14.0 mm, female, 11.4 mm, from Muroran, 25 Jun. 1971.

pereiopod III. Pereiopod V a little longer than pereiopod IV, 4th and 5th articles in large males expanded strongly.

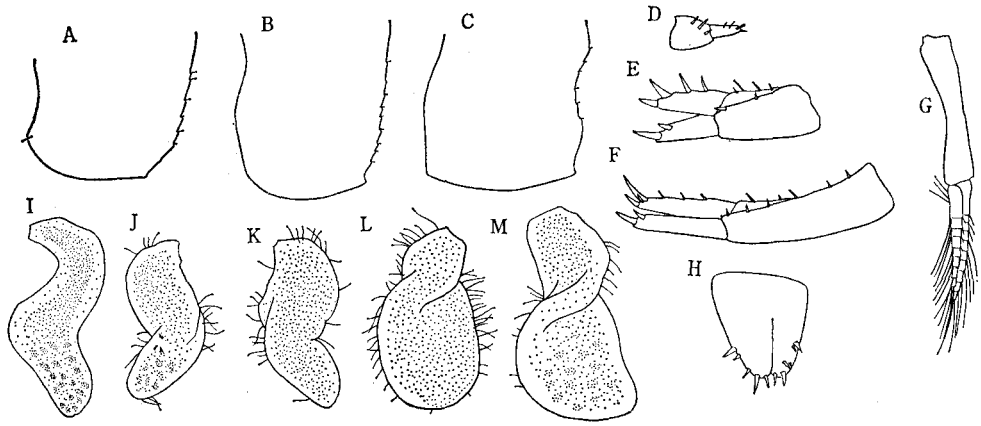
Pleopod well developed; peduncle longer than flagella which consist of about 8 to 9 articles in adult.

Epimeral plate I with slightly concaved anterior margin. Plate II with rounded antero-ventral corner. Plate III rectangular in form.

Uropod I with peduncle longer than rami; inner ramus and peduncle with spines on the dorsal margin; rami with apical spines. Uropod II with strong spines on the dorsal margin of peduncle to the tip of rami. Uropod III with ramus shorter than peduncle.

Telson triangular in form with a notch at the apex.

Gills with many hairy filaments; gill I longer than gills II and III; gill IV broad,



Text-fig. 6. *Orchestia pachypus*, A, epimeral plate I (X16.5); B, epimeral plate II (X16.5); C, epimeral plate III (X16.5); D, uropod III (X16.5); E, uropod II (X16.5); F, uropod I (X16.5); G, pleopod I (X16.5); H, telson (X27.5); I, gill I (X13.5); J, gill II (X13.5); K, gill III (X13.5); L, gill IV (X13.5); M, gill V (X13.5); male, 14.0 mm, from Muroran, 25 Jun. 1971.

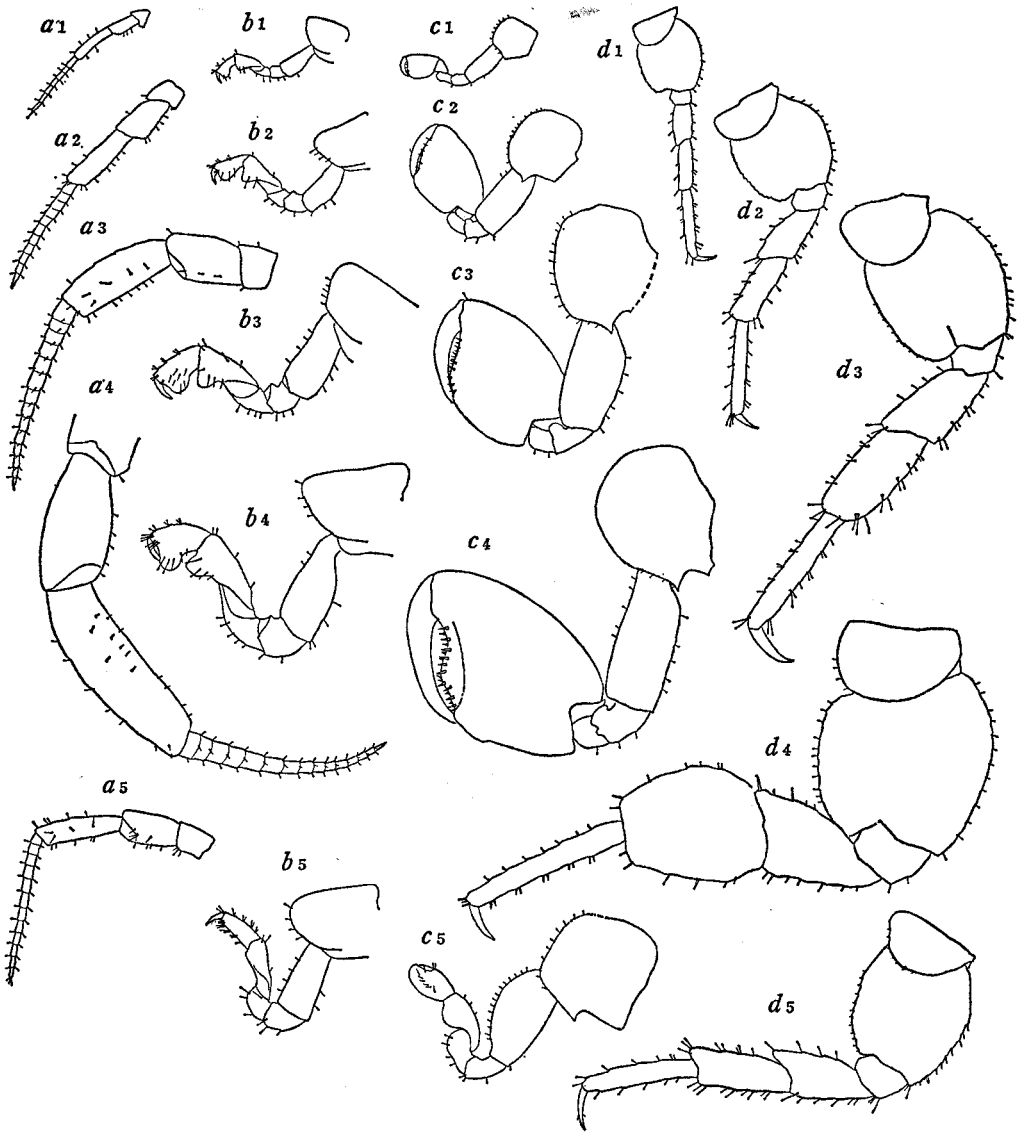
twisted in the proximal part; gill V longest of all, broad and constricted in the middle.

Oöstegite slender, with 30 bristles.

Distribution: For habitat see later section. This species occurs as abundantly as the preceding species in Japan, from Hokkaido to Kyushu (Fig. 16); also reported from the Kuril Islands, Aniwa Bay, the Gulf of Peter the Great.

Remarks: The present species based on the Russian specimens has originally been allocated to the genus *Talorchestia* by Derzhavin (1937), and this identification has been accepted by Gurjanova (1951) and Bulycheva (1957). The latter did it so because "gnathopod I of female simple". Iwasa (1939) synonymized the Japanese specimens of Derzhavin's species with *Talorchestia japonica* Tattersal reported from Lake Biwa and regarded this form as a subspecies of *Orchestia platensis*, thus describing it as *Orchestia platensis japonica* (Tattersal). This was because, to him, the female

gnathopod I did not seem simple but "feebly subchelate". Judging from the figures depicted by Bulycheva and Iwasa, however, Russian and Japanese specimens well accord with each other in detail. As the 6th article of female gnathopod I is provided with only a minute pellucid lobe at the distal corner, it seems hardly possible to express the feature definitely as simple or subchelate. Then, this requests some other



Text-fig. 7. *Orchestia pachypus*, successive change of secondary sexual characters, *a*, antenna II (X13.5); *b*, gnathopod I (X13.5); *c*, gnathopod II (X13.5); *d*, pereiopod V (X13.5); 1, 4.4 mm, 2, 7.4 mm, 3, 9.6 mm, 4, 14.0 mm, 5, female, 11.4 mm; 1,2 from Nagai, Obama in Fukui Prefecture; 24 May, 1971; 3, 4, 5 from Muroran, 24 May, 1971.

generic criteria to separate *Orchestia* and *Talorchestia* from each other. Morino (1972), comparing closely the structure, function and habitat between these two genera, admitted that *Talorchestia* and *Orchestia* trend adaptively towards the sandy beach and the gravel shore or wrack beds, respectively. Since the present species occurs under stranded matter on the gravel shore but is hardly seen on the sandy shore as is shown later, it is better treated under *Orchestia*.

Iwasa's treatment of this species as a subspecies of *Orchestia platensis* can not be accepted on the morphological and ecological ground. First, the difference in the form of 6th article of male gnathopod II between this species and *O. platensis* is marked enough for specific separation. In addition, expansion of 4th and 5th articles of pereiopod V is evidently peculiar to this species, though Iwasa regarded it as one of "no important differences between this (=*O. pachypus*) and preceding (=*O. platensis*)". Secondly, the two species clearly differ in their habitat preference.

Orchestia pyatakovi Derzhavin, 1937

(Text-figs. 8–11)

Orchestia pyatakovi, Derzhavin, 1937, pp. 89, Table II.
Orchestia tenuimana, Iwasa, 1939, pp. 268–271, Text-figs. 10–11.
Stephensen, 1944, pp. 63–65, figs. 20–21.
Orchestia pyatakovi, Gurjanova, 1951, pp. 805–806, fig. 560.
Bulycheva, 1957, pp. 172–173, fig. 62.

Material examined: Several specimens from Asamushi in Aomori Prefecture and Muroran in Hokkaido have been examined.

Description: Male larger than female.

Body large, more than 20 mm in length and more or less compressed laterally. Appendages slender and elongate. Eyes black, not large, oval in form.

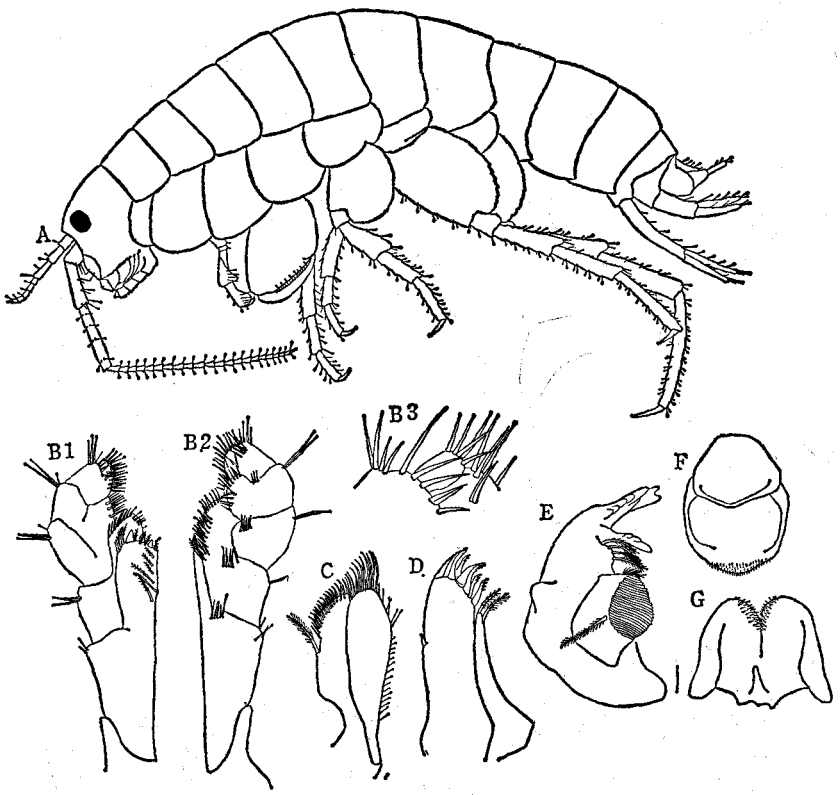
Antenna I almost reaching the middle of the ultimate peduncular article of antenna II; 1st article of peduncle longer than the others; flagellum consisted of 5 articles in adult, 20.4 mm in body length (cf. 3 articles, 6.4 mm in body length). Antenna II longer than one third of the body length; peduncle shorter than flagellum, ultimate article longest and nearly equal to the preceding two articles combined, armed with long slender spines; flagellum consisted of 21 articles in adult, 20.4 mm in body length (cf. 12 articles, 6.4 mm in body length).

Lower lip with minute inner lobe represented by a simple process. Maxillipedal palp consisted of 4 articles, the 4th minute but distinct.

Gnathopod I in male subchelate; 1st article longer than broad, much narrower than in following legs; each of 4th to 6th articles having a pellucid lobe, 5th article longer than 6th; 7th article not reaching the tip of pellucid lobe of 6th article; in female very similarly formed. Gnathopod II in male strongly developed; 1st article longer than broad with a small process on the posterior margin, 2nd article shorter than 6th and narrowed proximally, 6th article massive, the posterior margin nearly half as long as the anterior, palm nearly linear with spinules; in female 2nd article

proximally widen and slightly attenuated distally, other articles slender, 3rd article nearly equal to 4th, 5th article nearly equal to 6th, 3rd to 5th articles each with a pellucid lobe.

Pereiopod I similar to II, but the latter shorter than the former; 1st article of pereiopod I rectangular; 1st article of pereiopod II slightly pointed at the dorso-posterior corner, 7th article slightly notched. Pereiopod III much shorter than pereiopods IV and V, 1st article with two lobes, the anterior lobe much larger than the

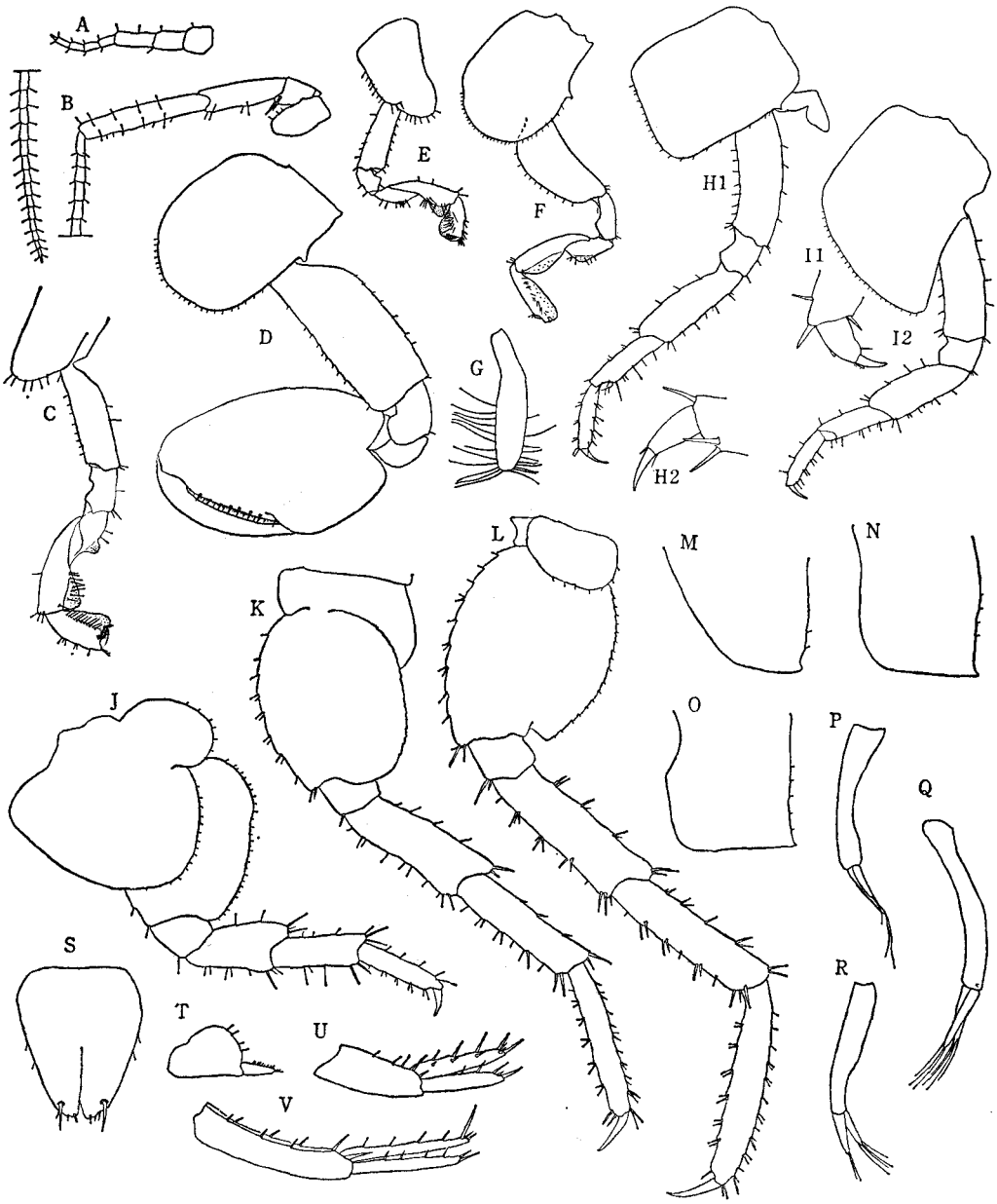


Text-fig. 8. *Orchestia pyatakovi*, A, lateral view (X10); B1, dorsal view of maxilliped (X40); B2, ventral view of maxilliped (X40); B3, distal articles of maxillipedal palp (X165); C, maxilla II (X40); D, maxilla I (X40); E, mandible (X40); F, upperlip (X27.5); G, lower lip (X27.5); A, male, 20.4 mm, B-G, female, 17.2 mm from Asamushi, 26 Jun. 1971.

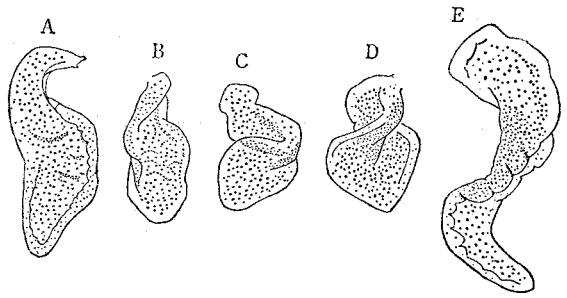
other, 2nd article expanded strongly with a slight concavity on the posterior margin. First article of pereiopod IV with two lobes, of which the posterior much larger. Pereiopod V very long, extending far beyond the tip of uropod III, 1st article single lobed, 6th article longest.

Pleopod degraded; flagellum represented by a single article.

Epimeral plate I gently curved antero-ventrally and with a few setae on the posterior margin. Plates II and III similar, rectangular at the postero-ventral



Text-fig. 9. *Orchestia pyatakovi*, A, antenna I (X8.5); B, antenna II (X8.5); C, male gnathopod I (X10); D, male gnathopod II (X10); E, female gnathopod I (X10); F, female gnathopod II (X10); G, oöstegite (X10); H1, pereiopod I (X8.5); H2, distal articles of pereiopod I (X32.5); I1, distal articles of pereiopod II (X32.5); I2, pereiopod II (X8.5); J, pereiopod III (X8.5); K, pereiopod IV (X8.5); L, pereiopod V (X8.5); M, epimeral plate I (X10); N, epimeral plate II (X10); O, epimeral plate III (X10); P, pleopod I (X16.5); Q, pleopod II (X16.5); R, pleopod III (X16.5); S, telson (X27.5); T, uropod III (X10); U, uropod II (X10); V, uropod I (X10); male, 20.4 mm, female, 17.2 mm from Asamushi, 26 Jun. 1971.



Text-fig. 10. *Orchestia pyatakovi*, A, gill I (X16.5); B, gill II (X16.5); C, gill III (X16.5); D, gill IV (X16.5); E, gill V (X16.5); male, 20.4 mm from Asamushi, 26 Jun. 1971.

corner, and each having several setae on the posterior margin.

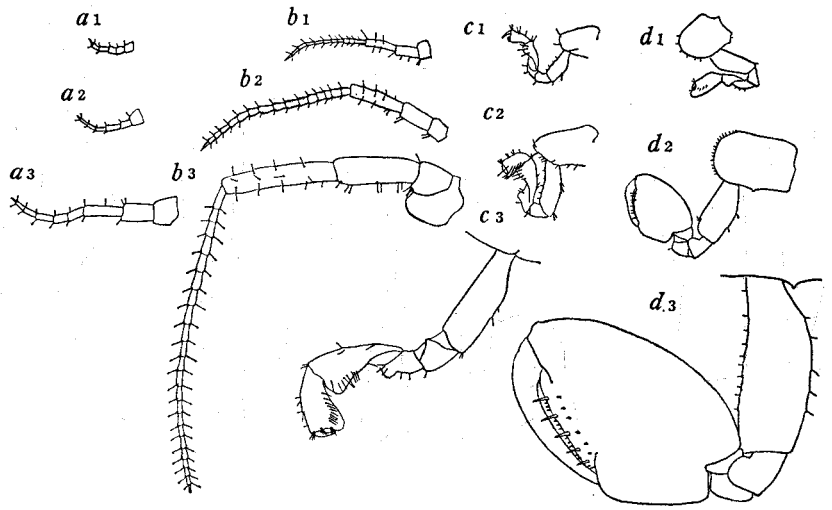
Uropod I extending beyond the tip of uropod II; peduncle longer than rami; both uropod I and II armed with many spines. Uropod III with peduncle much expanded and longer than ramus.

Telson elongate triangular in form, with a notch at the apex, with a few spines on the posterior margin of each lobe.

Gill surface more or less bumped; gill I long, curved in the middle. Gills II and III similar. Gill IV broad and twisted. Gill V longest, constricted in the middle.

Oöstegite slender with about 20 bristles.

Distribution: For habitat see later section. This species occurs from the middle of



Text-fig. 11. *Orchestia pyatakovi*, successive change of meristic and secondary sexual characters; *a*, antenna I (X8.5); *b*, antenna II (X8.5); *c*, gnathopod I (Z10); *d*, gnathopod II (X10); 1, 6.4 mm, 2, 11.3 mm, 3, 20.4 mm, 1, from Muroran, 25 Jun. 1971; 2–3 from Asamushi, 26 Jun. 1971.

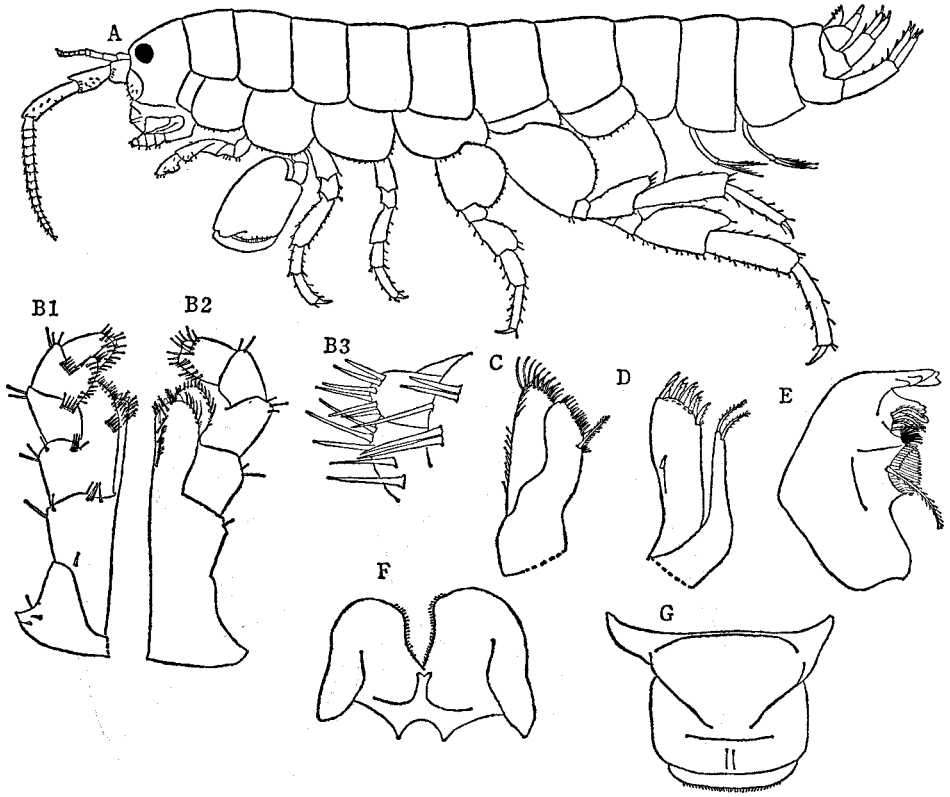
Honshu to Hokkaido in Japan, and Bulycheva has reported it from the Japan Sea and the Kuril Islands. Localities (Fig. 16): Jajima Island in Maizuru Bay, Kyoto Prefecture; Fushiki, Toyama Prefecture; Shimizu, Shizuoka Prefecture; Asamushi, Aomori Prefecture; Toga, Akita Prefecture; Oshoro, Akkeshi and Muroran in Hokkaido.

Orchestia ochotensis Brandt, 1851

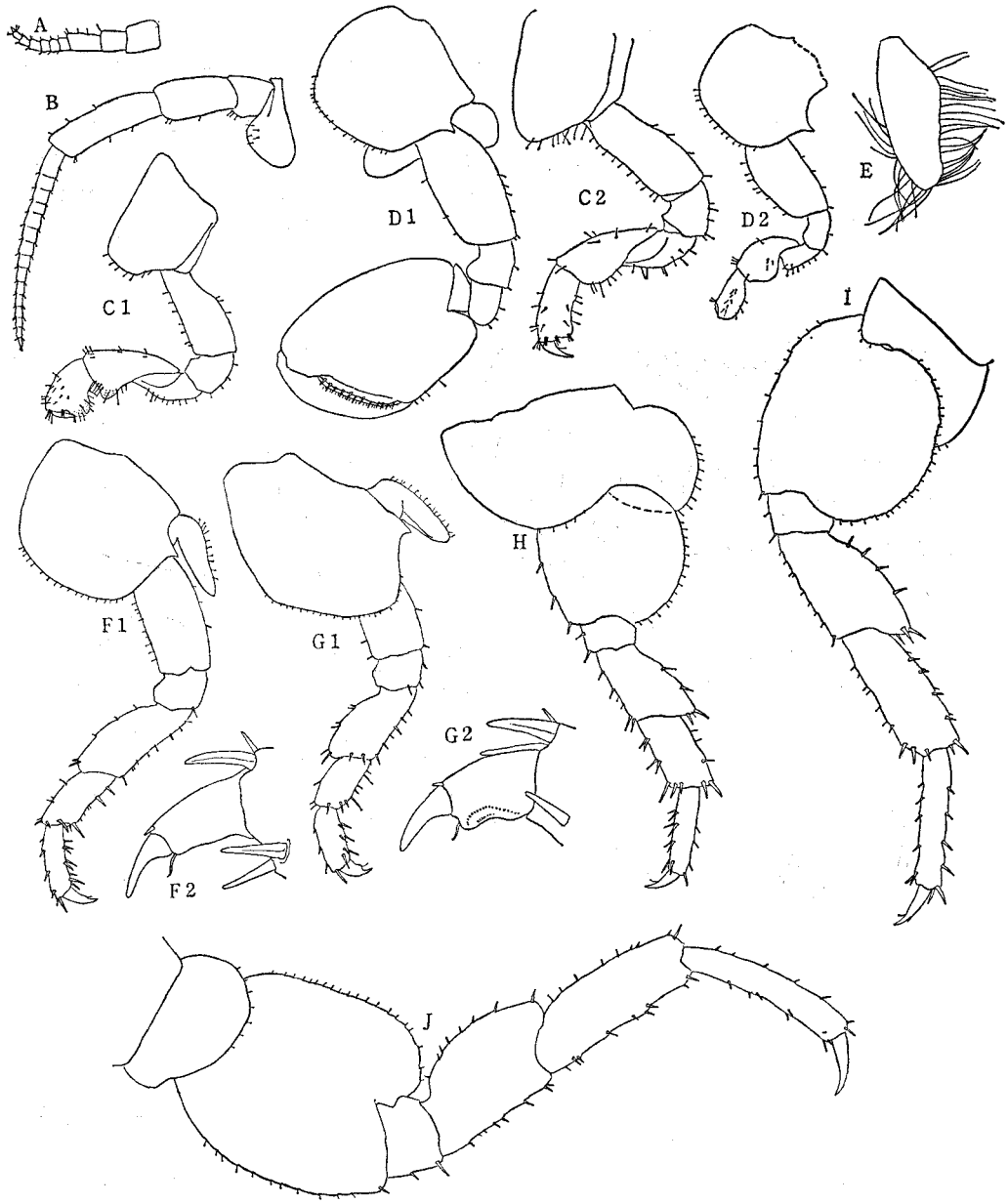
(Text-figs. 12–15)

Orchestia ochotensis, Brandt, 1851, pp. 140.
Orchestia ditmari, Derzhavin, 1923, pp. 187.
Uéno, 1935, pp. 90–93.
Iwasa, 1939, pp. 263–266, figs. 7–8, Pl. XI.
Stephenses, 1944, pp. 60–63, figs. 18–19.
Orchestia ochotensis, Bulycheva, 1957, pp. 166, 171–172, fig. 61.

Material examined: Several specimens from Nosappu in Hokkaido have been



Text-fig. 12. *Orchestia ochotensis*, A, lateral view (X10); B1, ventral view of maxiliped (X13.5); B2, dorsal view of maxilliped (X13.5); B3, distal articles of maxillipedal palp (X165); C, maxilla II (X13.5); D, maxilla I (X13.5); E, mandible (X13.5); F, lower lip (X13.5); G, upper lip (X13.5); male, 15.3 mm from Nosappu, 21 Jun. 1971.



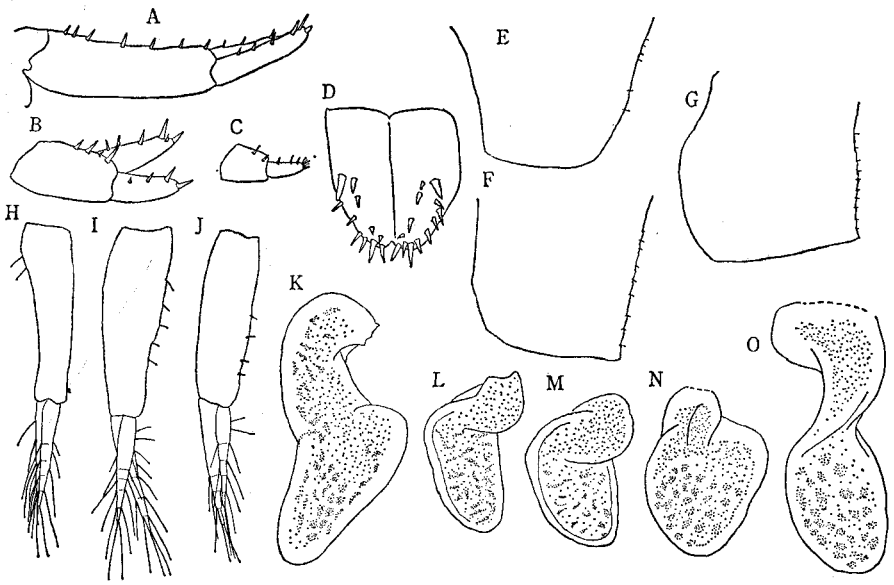
Text-fig. 13. *Orchestia ochotensis*, A, antenna I (X8.5); B, antenna II (X8.5); C1, male gnathopod I (X10); C2, female gnathopod I (X16.5); D1, male gnathopod II (X10); D2, female gnathopod II (X10); E, oöstegite (X10); F1, pereiopod I (X10); F2, distal articles of pereiopod I (X48); G1, pereiopod II (X10); G2, distal articles of pereiopod II (X48); H, pereiopod III (X10); I, pereiopod IV (X10); J, pereiopod V (X10); male, 19.1 mm, female 13.9 mm from Nosappu, 21 Jun. 1971.

examined.

Description: Male larger than female.

Body large and stout, more than 20 mm in body length. Eyes not so large, nearly circular and black.

Antenna I extending beyond the antipenultimate article of peduncle of antenna II; 2nd and 3rd articles of peduncle nearly equal and each shorter than 1st article; flagellum consisted of 6 articles in adult, 19.1 mm in body length (cf. 3 articles, 7.1 mm in body length). Antenna II about one third of the body length; peduncle nearly equal to flagellum, ultimate article nearly equal to the preceding two articles



Text-fig. 14. *Orchestia ochotensis*, A, uropod III (X13.5); uropod II (X13.5); uropod I (X13.5); D, telson (X27.5); E, epimeral plate I (X13.5); F, epimeral plate II (X13.5); G, epimeral plate III (X13.5); H, pleopod I (X16.5); I, pleopod II (X16.5); J, pleopod III (X16.5); K, gill I (X16.5); L, gill II (X16.5); M, gill III (X16.5); N, gill IV (X16.5); O, gill V (X16.5) male 19.1 mm from Nosappu, 21 Jun. 1971.

combined; flagellum consisted of 17 articles in adult, 19.1 mm in body length (cf. 10 articles, 7.1 mm in body length).

Lower lip with minute inner lobe. Maxillipedal palp consisted of 4 articles, 4th minute but distinct.

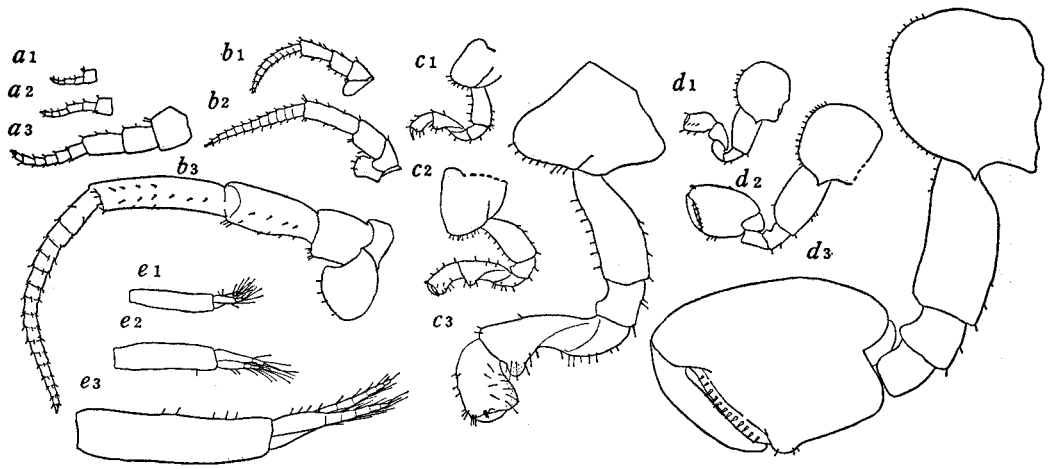
Gnathopod I in male subchelate; 1st article longer than broad, narrower than in following legs, 5th article longer than 6th, each with a prominent pellucid lobe, 7th article short, not reaching the tip of pellucid lobe; in female subchelate, without pellucid lobe. Gnathopod II in male strongly developed; 1st article broader than long, 2nd article shorter than 6th, 6th article massive and swollen in large specimens, trapezoid in form, palm slightly sinuated and with a pellucid lobe; 7th article in

female minute, never extending beyond pellucid lobe of 6th article.

Pereiopod I similar to II, the latter shorter than the former; 7th article of pereiopod II notched strongly. Pereiopod III shorter than IV and V, in which pereiopod V longest, 1st article of pereiopod III bi-lobed, 2nd article expanded broadly and with setules on the posterior margin as in pereiopods IV and V. First article of pereiopod IV bi-lobed, the posterior lobe larger than the anterior. In pereiopod V, 1st article simply lobated, 4th article incrassated in large males, 5th and 6th articles slightly curved.

Pleopod not well developed; peduncle longer than flagella which consisted of 5 articles in adult, 19.1 mm in body length (cf. 3 articles, 7.1 mm in body length).

Epimeral plate I rounded at the postero-ventral corner and with a few setae on the posterior margin. Plates II and III similar, the postero-ventral corner rectangular



Text-fig. 15. *Orchestia ochotensis*, successive change of meristic and secondary sexual characters; *a*, antenna I (Z10); *b*, antenna II (X10); *c*, gnathopod I (X10); *d*, gnathopod II (X10); *e*, uropod I (X10); 1, 7.1 mm; 2, 10.5 mm; 3, 15.3 mm, from Nosappu, 21 Jun . 1971.

and with setules on the posterior margin which weakly serrated.

Uropod I extending beyond the tip of uropod II, peduncle twice as long as rami, armed with many spines on peduncle and rami. In uropod III peduncle nearly equal to ramus.

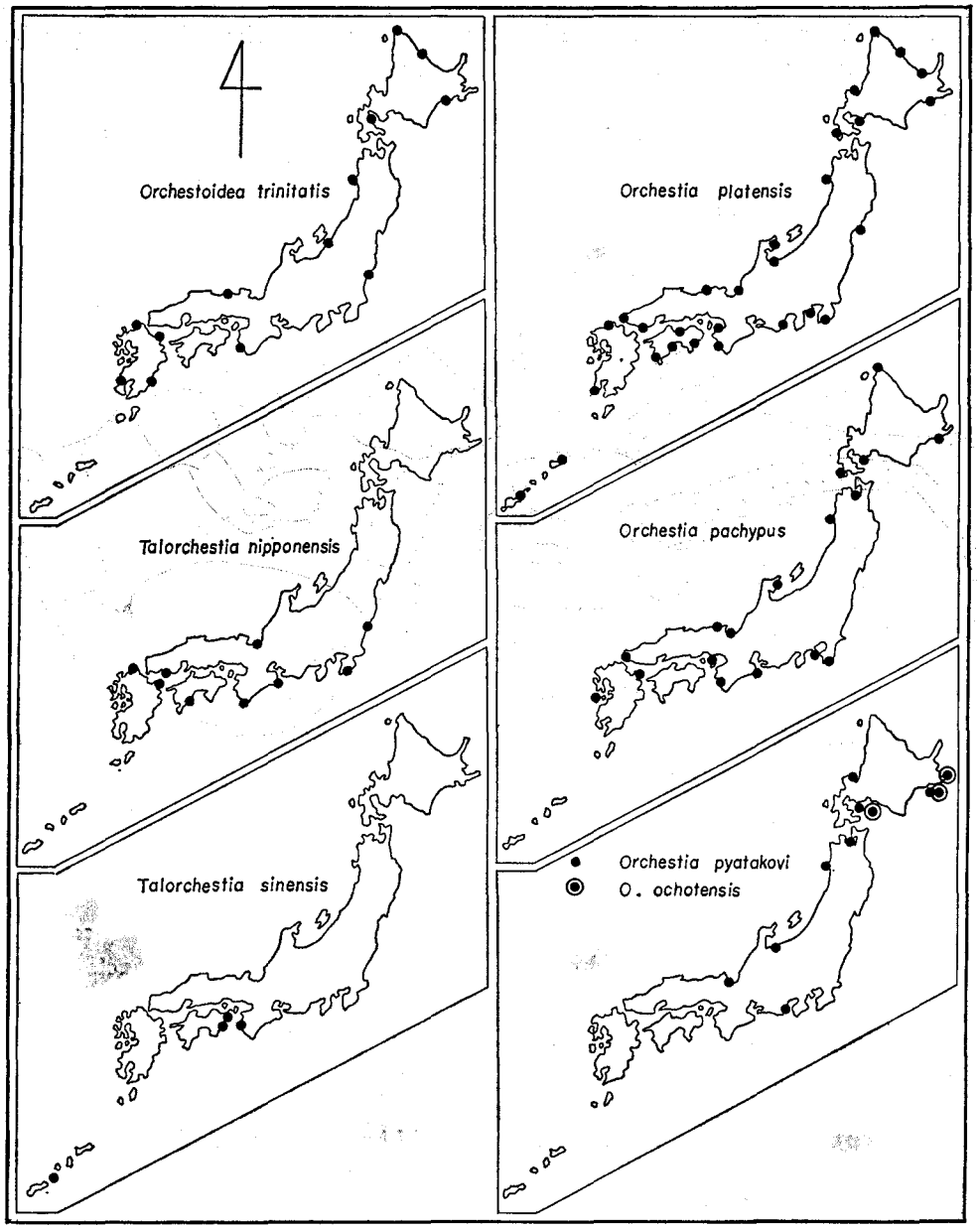
Telson with a notch at the apex, and armed with many short spines in the distal half.

Gill I long, slightly curved in the middle. Gills II and III similarly short and bent rectangularly in the proximal part. Gill IV broad and twisted. Gill V long, constricted in the middle.

Oöstegite broad, with more than 30 bristles.

Habitat: Under the stranded sea-weeds on the rocky shore. In Nosappu, Hokkaido, wearily hopping and jumping animals were observed, though Iwasa stated, "...they (=this species) never hop like *O. platensis* does."

Distribution: This species occurs in Hokkaido, the Kuril Islands and Sakhalin. Localities (Fig. 16): Tonnaiko in the Southern Kuril, Syana in Itrup Island of the Southern Kuril; Akkeshi, Muroran and Nosappu in Hokkaido.



Text-fig. 16. Maps showing the geographical distributions of sea-shore talitrids in Japan. The data include a few records furnished by my colleagues other than those obtained by myself.

The Habitats of Sea-Shore Talitrids

As pointed out already in my preceding paper (Morino, 1972), there is seemingly a relation between the habitat and body shape in sea-shore talitrids. This means that the species of a similar body shape live in similar habitats, though some differences in habitats do exist between the species closely related one another. In this section are discussed the similarity and difference in the habitat of 6 species of the Talitridae, *Orchestoidea trinitatis*, *Talorchestia nipponensis*, *T. sinensis*, *Orchestia platensis*, *O. pachypus* and *O. pyatakovi*. *Orchestia ochotensis* is excluded, since it has been observed only once.

Method of habitat examination: Sampling and observation have been done on 117 shores in all, from northern tip of Hokkaido to Yoron Island in Kagoshima Prefecture. The animals were caught by digging sandy shore, or directly by hand with the help of insecticide in cases of wrack dependent species. In each sampling, effort were made to collect the whole specimens in an unit area (about 30×30 cm). On the wide uniform shore samplings were done at several unit areas, but only a single area was selected on narrow shores. Conditions and nature of the substratum and stranded matters were checked and photographed, and the behavior of animals was observed. Exact identification was done after the samples were brought back to the laboratory. Results of examination show that the talitrids occurred either in a single species or mixed with another species in every areas. Table I shows the frequency of respective species combination observed in sampling. For example, *Orchestoidea trinitatis* was caught on 16 shores in all, 3 times mixed with *Talorchestia nipponensis*, 5 times mixed with *Orchestia platensis* and 8 times singly.

Table 1. Frequency of respective species combination observed in samplings.

	Orchestoidea trinitatis	*Talorchestia nipponensis*	*T. sinensis*	*Orchestia platensis*	*O. pachypus*	*O. pyatakovi*
Orchestoidea trinitatis	8	3		5		
Talorchestia nipponensis	3	2		3		
T. sinensis			2	1		
Orchestia platensis	5	3	1	43	7	
O. pachypus				7	13	5
O. pyatakovi					5	1
Total	16	8	3	59	25	6

Brief Description of the Habitat of Respective Species

(1) *Orchestoidea trinitatis*

This large and cylindrical species was collected on 16 shores, from Hokkaido to Kyushu (Fig. 16). In every case, the shore was the wide and fine sandy beach.

There the animals were mostly found burrowing deep in sand, but never living under stranded matters. Thus its habitat is independent of stranded matters. It seems likely that it requires some thickness of fine sand. On 3 shores it was collected mingled with *Talorchestia nipponensis* also living in sand, on 5 shores with *Orchestia platensis* limitedly living under stranded matter.

(2) *Talorchestia nipponensis*

This species, not so large and more or less cylindrical in shape, was collected on 8 shores from middle Honshu to Kyushu (Fig. 16), 3 times burrowing deep in sand and mixed with *Orchestoidea trinitatis*. On 3 shores, it was caught together with *Orchestia platensis* from under stranded matters on sandy beach. Thus, its habitat seems to be more extended than *Orchestoidea trinitatis*.

(3) *Talorchestia sinensis*

This species, not so large and more or less cylindrical in shape, was collected on 3 shores from Yoron Island up to Shioyahama, Gobo in Wakayama Prefecture (Fig. 16). On one shore it was found burrowing deep in sand, just like *Orchestoidea trinitatis*, but in other two cases it was seen under stranded matters on sandy beach. Thus, the habitat conditions are very similar to those for *Talorchestia nipponensis*.

(4) *Orchestia platensis*

This small and more or less compressed species was collected on 59 shores and observed on more shores. It occurs exclusively under stranded matters, more exactly saying, living between the substratum and stranded matters, though the substratum conditions vary from fine sandy beach, where the species frequently occurs with *Orchestoidea trinitatis*, to sandy and pebbly shores. It has never been found together with *Orchestia pyatakovi*.

(5) *Orchestia pachypus*

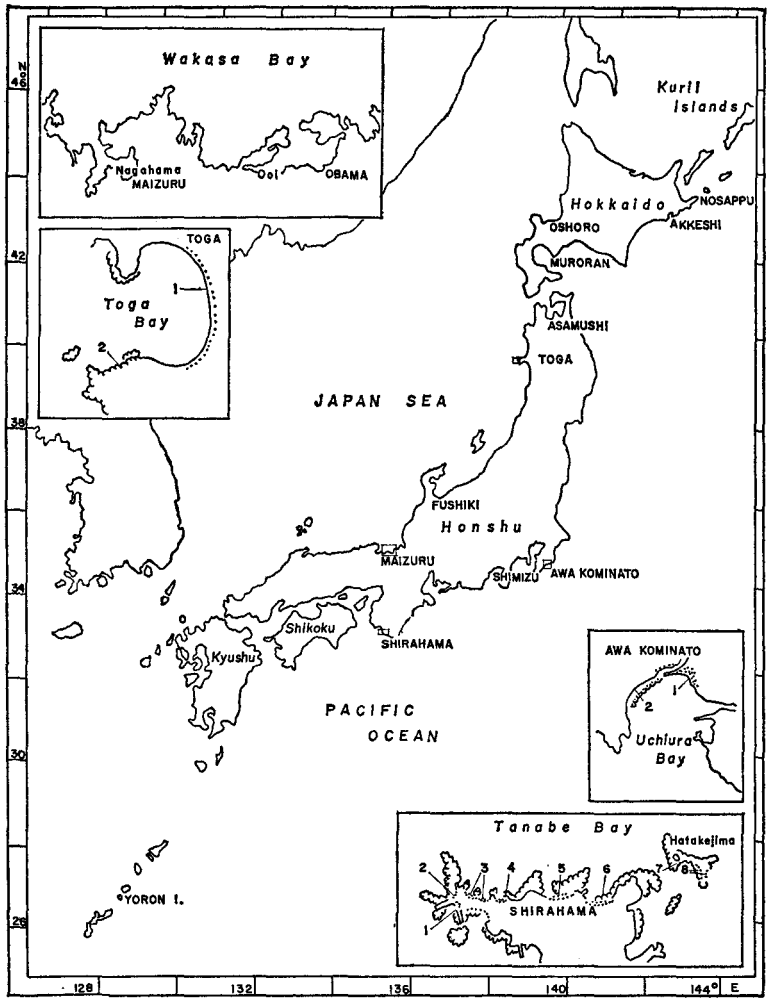
This small and more or less compressed species was collected on 25 shores, from Hokkaido to Kyushu, but none never in Shikoku. The microhabitat on shore depends on the stranded matters, just like the case of *O. platensis*. The substratum varies from the hard sandy to pebbly beach. It was frequently caught mingled with *O. pyatakovi* but never with *Orchestoidea trinitatis*.

Table 2. Four types of sea-shore talitrids based on their habitat and body shape.

Type	Habitat	Body shape	Species
1	stranded matter independent. substratum: fine sand.	large, cylindrical.	*Orchestoidea trinitatis*
2	stranded matter independent or dependent. substratum: fine sand to sand.	not so large, more or less cylindrical.	*Talorchestia nipponensis* *T. sinensis*
3	stranded matter dependent. substratum: muddy sand to pebbles.	small, slightly compressed.	*Orchestia platensis* *O. pachypus*
4	stranded matter dependent substratum: pebbles	large, compressed.	*O. pyatakovi*

(6) *Orchestia pyatakovi*

This large and compressed species was collected on 6 shores, from Hokkaido to middle Honshu (Fig. 16). The habitat is stricly confined to the shores where pebbles accumulate to some depth, and there the animal were found usually under stranded matters, but they escaped very quickly into the interspace between pebbles when



Text-fig. 17. Map of Japan and four enlarged areas cited in the text.

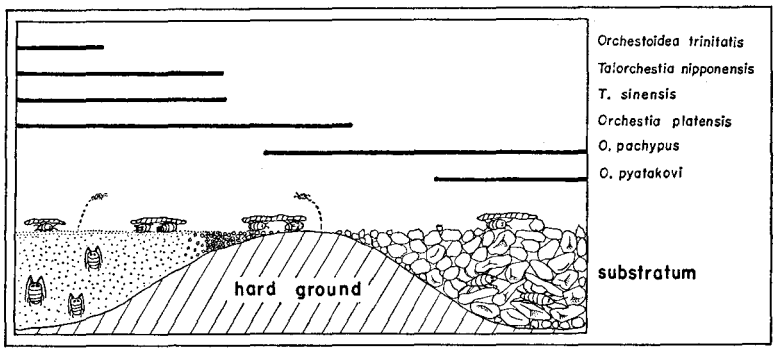
disturbed. On 5 shores it was captured together with *O. pachypus*, but never with *O. platensis*.

General Considerations on the Habitats

The 6 species referred to above can be grouped together into the following 4 types on the ground of their habitat and body shape. As was discussed in the preceding

paper in detail, there is an evident relation between the habitat and body shape, and through the types 1 to 4 shown in Table 2 the species with cylindrical body tend to live burrowing in the sand, while the species with compressed body are apt to live in the narrow interspace between pebbles or under the stranded matter.

The habitat of *Orchestia platensis* and *O. pachypus* are both dependent on the stranded matter, but differ from each other in the nature of substratum. As has been stated elsewhere, *O. platensis* has never been captured mingled with *O. pyatakovi*, while *O. pachypus* has never captured with *Orchestoidea trinitatis*. These facts, together with the already known habitat characteristics of *Orchestoidea trinitaits* and *Orchestia pyatakovi*, seem to suggest that *O. platensis* prefers the substratum of fine sand, avoiding the pebbly substratum, and *O. pachypus* favors the pebbly beach, avoiding the substratum of fine sand. When *O. platensis* is found on the pebbly shore, pebbles are not accumulated to any depth but scattered on the hard ground. When *O. pachypus*



Text-fig. 18. Diagram showing the ranges of substratum preferences of sea-shore talitrids: Above, thick lines show the ranges, when they are not overlapped, these species have not been captured together. Below, showing the mode of existence in the respective conditions of substratum.

is found on the sandy shore, the substratum is very hard or of coarse sand.

In Toga Bay, Akita Prefecture, *O. platensis* occurred, together with *Orchestoidea trinitatis*, in the inner part of the bay, where sandy beach is developed (1 in Toga Bay, Fig. 17). On the other hand *O. pachypus* was found with *O. pyatakovi* near the mouth of the same bay, where pebbles are accumulated (2 in Toga Bay, Fig. 17). The similar distributional pattern was seen also in Uchiura Bay of Awa Kominato, Chiba Prefecture. There, *O. platensis* was caught mingled with *Talorchestia nipponensis* on the sandy beach in the inner part of the bay (1 in Uchiura Bay, Fig. 17), while *O. pachypus* was found on the pebbly beach nearer to the bay mouth.

On the southern coast of Tanabe Bay and Hatakejima Island in the bay, Wakayama Prefecture, *O. platensis* has been collected on sandy beach of stations 2, 3, 4, 5, 6 and 8 (Shirahama, Fig. 17). *Orchestoidea trinitatis* occurs also at stations 5, 6 and 8. On the other hand, *O. pachypus* has been collected invariably only at stations 1 and 7, though recently collected at station 4, too. Beaches at station 1 and 7 are of rather

coarse sand.

From above observations, the wave action might be taken as another possible factor characterizing the habitat of respective species. Thus *O. pachypus* might prefer less protected beach. However, this species have been met with in almost completely protected beach as at Nagahama or Ooi in Wakasa Bay (Fig. 17), though *O. platensis* has not been seen in the neighbourhood, much more comparative observation of the two habitats will be necessary to gain conclusion on this point.

The habitat of *T. nipponensis* is clearly similar to that of *T. sinensis*, and both species have never been seen together. But the latter has been observed so few time that it is impossible to compare the two habitats in detail.

The habitats of the respective species are schematically depicted in Fig. 18 to show the difference in the nature of substratum.

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